

STEREO MOC Status Report
Time Period: 2017:317 - 2017:323

STEREO Ahead (STA) Status:

1. The following Ground System anomalies/events occurred during this reporting period:

- On day 317, during the DSS-25 support, a DSN demonstration test was conducted to validate SLE telemetry server operations and data delivery with TT&C software V1.4. As this was a test track, there was no SSR playback or instrument commanding. In the MOC, real-time telemetry and monitor data services were nominal and four commands were successfully received by the Ahead observatory.
- On day 321, during the DSS-34 support, turbo decoder lock was lost intermittently between 0839z and 0844z and briefly at 0917z. This anomaly resulted in the loss of 4236 frames of real-time and SSR data. See DR #C113040 for more information.
- On day 321, during the DSS-84 support, the transmitter tripped off-line at 2123z and remained unavailable for the remainder of the track. This anomaly resulted in the loss of 2.4 hours of commanding and tracking data and several seconds of SSR data loss during the transition from two-way to one-way communications.

2. The following spacecraft/instrument events occurred during this week. The Ahead observatory operated nominally during this week.

- On day 319, the 104th momentum dump was executed successfully at 1600z, which imparted an estimated delta V of 0.098 m/sec. This was the 23rd momentum dump that did not use the IMU. After thruster operations complete, there was a 0.39 degree of roll angle error which was dampened out over the next 14.6 minutes. Fine pointing stabilized 2.2 minutes after completion of the momentum dump.
- On day 320, the PLASTIC SSR science partition (#17) reached 95% full and began recording only housekeeping data at 1509z for 14 minutes due to insufficient track time.

- The average daily science data return for Ahead was 4.8 Gbits during this week.

STEREO Behind (STB) Status:

1. Detailed status of the recovery activities this week to restore operations is listed below.
 - On day 317, during a 2.6 hour 4 kHz carrier recovery support with DSS-63, 260 commands were transmitted during the support. No carrier was detected by either the DSN station or the radio science receiver team after attempting to power on the TWTA for 30 minutes. Transitioned to battery recovery operations for the remainder of the support which consists of repeatedly sweeping a 4 kHz uplink range and sending commands for IEM switched power and PDU 1553 interface bus off.
 - On day 320, during a 3 hour 4 kHz battery recovery search pattern support with DSS-63, 320 commands were transmitted during the support. All 7 points on the pattern were covered twice.
 - On day 322 during a 3 hour 4 kHz carrier recovery search pattern support with DSS-63, 320 commands were transmitted during the support for carrier recovery. No carrier was detected by either the DSN station or the radio science receiver team. All 7 points on the pattern were covered twice. Three commands must be received sequentially to power on the transmitter.
2. The Behind loss of communication anomaly occurred on October 1, 2014 from simultaneous failures of star tracker and IMU. Post superior solar conjunction, recovery operations resumed on November 30, 2015. By implementing the NASA Failure Review Board recommendations, the first recovery attempt began with carrier detection by the DSN on August 21st, through September 23, 2016. At a spacecraft range of ~2 AU, the observatory was found to be rotating slowly about its principal axis of inertia for which the uncontrolled attitude allowed some solar array input and continuous uplink and downlink communications on the LGA at emergency data rates. Over the next 22 continuous days, significant obstacles to recovery were overcome with a collaborative effort of the JHU/APL engineering team, NASA GSFC, DSN, FDF, SSMO scheduling, and Mission Operations teams. This consisted of:

- Reliably commanding a rotating spacecraft with uncontrolled attitude at a distance of 2 AU
- How to power on the spacecraft that was never designed to be off without collapsing the battery voltage
- Acquiring telemetry at 35 bps from a spacecraft that is rotating with an uncontrolled attitude
- Warming a frozen propulsion subsystem with a degraded battery and limited solar array input with an uncontrolled attitude
- Configuring, loading, and verifying EA, C&DH, and G&C parameters and macros with very limited telemetry
- Conducting an autonomous momentum dump in the blind and transitioning to C&DH standby mode and successfully receiving telemetry on the HGA indicating star tracker lock and decreasing system momentum.

However, system momentum level remained above the threshold for re-establishing attitude control with the reaction wheels. Due to the uncontrolled attitude, communication degraded and the last detection of the carrier was on September 23, 2016.

Behind Observatory Status - From the last telemetry received on September 18, 2016 and the telemetry assessment review held on February 24, 2017, main bus voltage is low, 3 out of 11 battery cells are bypassed, attitude remains uncontrolled, rotating about its principal axis of maximum moment of inertia. While likely all ~42 kg of hydrazine remains and is frozen, both pressure transducers are not functioning. EA mode is enabled and autonomy is disabled. The battery charge rate is C/10. RF is configured for the +Z LGA at emergency data rates and the range of the expected best lock frequency (BLF) is known. Necessary macro sequences have been tested to allow the peak power tracker in C&DH standby mode to protect the battery. These macro sequences will be loaded to EEPROM when the communications supports longer commands.

After 2.5 months of daily recovery efforts that began on August 21st, to date the downlink signal has not been detected by the DSN block V receivers or the RSR team. With significant support of the DSN, two different acquisition sequences are being utilized weekly to re-establish communications with STEREO Behind using a 70m track:

1. 4 kHz Sweep - consists of repeatedly sweeping a 4 kHz uplink frequency range for which the BLF was found during

the first recovery attempt. Commands are sent to power on the transmitter for 30 minutes. If no carrier signal is detected, the transmitter is powered off and battery recovery commands are sent consisting power off the IEM switched power and PDU 1553 interface bus. This acquisition sequence is used 3 times each week.

2. 4 kHz Sweep with Search Pattern - The DSN created a diamond shaped search pattern with 7 steps of 0.037 deg, dwelling 10 min & 49 sec/step. There are two diamond patterns of 4 steps to cover the area of the estimated ephemeris error. The starting point is offset 0.02 deg for 100% uplink optimization. Repeating each diamond pattern accounts for the 30 minute RTLT. This search pattern acquisition sequence is used twice weekly during 3 hour supports, sending battery recovery commands at each step during the first day and on the second day, sending carrier recovery commands at each step.